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THE JOURNAL
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VOL. XXXVIII, No. 3 MARCH, 1944 WHOLE No. 332

ASTRONOMY IN A WORLD AT WAR

By A. VIBERT DOUGLAS

(THE ADDRESS OF THE PRESIDENT OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA)

I

SCIENCE has advanced during the last four years both because and in spite of war. Some of the sciences have made tremendous strides as a direct result of the challenge of war necessities. Physics, chemistry, metallurgy, and all the branches of medical science are in this category; some day the full story of their great achievements may be made known. Other branches of knowledge, while far from being unaffected by the war, have continued to advance largely in spite of the upheavals in the life of nations and individuals which world war inevitably brings. Astronomy is in this latter class.

Astronomy and astronomers are playing an important part in the war chiefly along the two lines which have always presented fundamentally stellar problems—direction and time. But the main advances in astronomy in these last four years have been made in spite of the war. It is right and fitting and indeed very encouraging that this is the case. When so much that is of intrinsic beauty and of fundamental value is being destroyed by war, and when so many worthwhile activities have to cease, it is good indeed to know that there are astronomers on this continent, and even in some parts of Europe, and in Australia, Africa, India, and probably in Japan, who are able to carry on the continuity of observations on stars and starlight, sun and moon, planets and asteroids, comets and meteors.

If the continuity of observation in many branches of astronomical work were to be completely broken, it would be an irreparable loss to science. Thus it is with satisfaction and great admiration that we read in the Reports of the Royal Observatory, Greenwich, that damage done by enemy action to one of the buildings and to the Airy transit circle has been largely made good, and observations recommenced with that instrument upon Sun, Venus and the stars in the clock and azimuth lists; that parallax determinations are going on; that solar photography and observations of chromospheric eruptions in Hα are continuing; and that the two Time Service Stations have operated continuously. During this period the exhaustive work on the Solar Parallax was brought to completion.

In France solar, planetary and stellar research have been carried on, and in Holland galactic problems, long period variables, dark nebulosity and theoretical astrophysics have been under investigation even in these tragic years. In the U.S.S.R. where at least one observatory has been destroyed and another dismantled, plans are already made for resumption of activity and for the erection of a new observatory to further the study of latitude variations. From two observatories east of the farthest battle front we know that papers have been published recently on photo-electric calorimetry and on colour temperatures.

Similar records of observations and measurements carried on despite air raids, despite reduction of staff, despite pressing war problems and difficulties of all kinds, could be quoted from many observatories in countries deeply involved in fighting for their very existence.

In these and in countries like our own,—at war, but far removed from the main theatres of conflict—there has been a very important contribution made by astronomers in the adaptation of astronomical observations and calculations to the problems of air navigation. The Director of the Glasgow University Observatory, Professor W. M. Smart, has produced three books on Nautical Astronomy since this War began, and under his instruction, R.A.F. pilots and cadets are learning the art and science of navigation. Scores of astronomers, including Canadian men well known to many of us, are doing similar work, giving all their time, skill

and energy, and often risking their lives in the air with student pilots, in order to impart this so necessary instruction in air navigation.

In the Koran, it is written: "God has given you the stars to be guides in the dark, both by land and sea." Homer tells of Ulysses on his raft that he sat at the helm and "marked the skies, nor closed in sleep his ever watchful eyes." But navigation from the back of a camel or from the bridge of a ship can be a relatively leisurely performance. Not so in a modern airplane! The navigator takes a sight on a star or planet, he reads his chronometer, and then if his calculations take him five minutes to perform, he and his plane are already perhaps twenty-five miles away from the ascertained position. Every minute that astronomers have been able to cut off the time for computation of position is of the greatest value to airmen flying over seven seas and six continents, across enemy lines, with objectives a mere dot on the map—a railway yard, a factory, an airfield.

II

Turning to the subject of time measurement, it is worthy of note that during these war years an accuracy never before dreamed of has been attained. It was in April 1938, that Essen described before the Royal Astronomical Society of London, the researches at the National Physical Laboratory which had resulted in the new quartz clock, of which so much was hoped. This clock makes use of the properties of the crystal oscillator, one of the most reliable and perfect mechanical systems known to man. Essen describes quartz clocks briefly as "consisting of phonic motors controlled via frequency dividers by vibrating quartz crystals." In a paper presented to the Royal Astronomical Society last June, Greaves and Symms record the intercomparisons of three Greenwich free pendulum Shortt clocks, two National Physical Laboratory quartz clocks, and three quartz clocks at the Post Office Radio Branch Laboratories.

They analyze clock errors into three classes (a) erratic variations in phase, (b) erratic variations in rate, (c) a combination of phase and rate variations, producing a cumulative effect. They show that two Shortt clocks and two quartz clocks may indicate

approximately the same mean absolute second differences of relative clock error, but the distribution of errors between the three classes is different—the quartz clocks show very little error of (b) and (c) relative to Shortt clocks, and errors of class (a) do not affect the long-period performance of a clock.

The famous Shortt clocks are now known to be incapable of giving the precision demanded, but the Astronomer Royal hastened to pay them a deserved tribute:

> Twenty years ago we had several papers dealing with the performance of the Shortt clocks, then looked upon with great expectations. In this clock was achieved in a simple and beautiful manner what horologists had been striving after for years, namely, a pendulum designed solely for the purpose of beating time whilst being called upon to perform no mechanical work. But if the subsequent performance of this type of clock did not fully come up to our high expectations, the Shortt Free Pendulum has one thing to its everlasting credit—it forced the astronomers to adopt the use of Mean Sidereal Time where formerly True Sidereal Time had been adequate. During the intervening twenty years since this type of clock was installed in many observatories, new requirements have sprung up. In the past the main purpose of a time service was to provide absolute time with an accuracy sufficient for navigational and surveying requirements. But the new use of frequency standards has raised a demand for 24-hour intervals correct to the very high accuracy of a millisecond.
>
> It will be seen then that as absolute standards at Greenwich, Shortt clocks have become obsolete. Our long-range predictions are now based entirely on quartz clocks, free pendulum clocks being used only for extrapolation over an interval of 24 hours.

III

Let us turn our thoughts to cosmology and recall that it was during the first World War that Einstein's general theory of relativity appeared. Two years later, in the war year 1917, came the first suggestion of an expanding universe. This was one interpretation of de Sitter's modification of Einstein's cosmology, implying as it did red shifts of the spectrum lines of faint distant objects. Incidentally, we may turn aside to remark that while de Sitter was then working in a Holland that had been allowed to remain neutral, his spirit is living on in the occupied and battered Holland of this war, and he, though dead, yet speaketh, inspiring his successors at Leiden and Amsterdam to carry on the tradition of astrophysical research in spite of all external difficulties—thus Verweij has produced a theoretical discussion of Stark effect in stellar spectra

which was published in Holland and found its way to the United States of America just before the entry of that country into this war. Perhaps I may add that Verweij in that paper dealt a hard blow at a paper by a McGill colleague and myself, though I do not accept it as a knock-out blow. Further research on this controversial subject is now in progress at the Dominion Astrophysical Observatory.*

De Sitter had also deduced from Einstein's theory the four conclusions which offered a hope of observational confirmation. One of these four crucial tests was whether radiant energy passing close to a body with an intense gravitational field surrounding it, would be deflected in accordance with Newton's law of gravitation or with Einstein's modification of that law. It was Professor A. S. Eddington who realized the great importance of making this test at the first favourable opportunity, namely, at the time of the total solar eclipse which was to occur on May 29th, 1919, with the Hyades as background. War or no war, all the plans and preparations were pushed ahead and thus it was that when the eventful day arrived, even though the Treaty of Versailles had not yet been signed, two British expeditions were in readiness to take the crucial photographs. I often reread the passage written by a learned mathematician and philosopher in which he described the meeting of the Royal Society when the results of these eclipse expeditions were announced, verifying as they did the theory of Einstein:

> The whole atmosphere of tense interest was exactly that of the Greek drama; we were the chorus commenting on the decree of destiny as disclosed in the development of a supreme incident. There was dramatic quality in the very staging;—the traditional ceremonial, and in the background the picture of Newton to remind us that the greatest of scientific generalisations was now, after more than two centuries, to receive its first modification. Nor was the personal interest wanting: a great adventure in thought had at length come safe to shore. (*A. N. Whitehead.*)

De Sitter's expanding universe suggested an outward motion of the stellar bodies within the framework of space as defined by his modification of the Einstein equation of spacetime geometry.

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*NOTE: Recent work from D.A.O. and from U.B.C. points to a confirmation of the work of Foster and Douglas on the interpretation of helium profiles by Stark effect.

Ten years later, Lemaître, who had fought with the Belgian army in the war years and afterwards entered Louvain University, brought forward his theory of expanding space. This made the radius of curvature of space a function of time, and gave a new stimulus to the astronomers in those great observatories equipped to probe most deeply into space. In the following years, at Mt. Wilson and Harvard particularly, the exploration of space was carried on with vigour, and methods were found of estimating the distances of the remote galaxies. A special lens was designed to obtain their spectra at Mt. Wilson, and thanks to the broad strong H and K lines of ionized calcium, red shifts could be measured to distances estimated as 250,000,000 light years. The correlation between distance and red shift has provided a remarkable confirmation of the theory of the expanding universe. Recessional velocities up to one seventh the velocity of light have now been observed. In the years between the wars a few voices were heard to question the interpretation of the red shift as a Doppler displacement, but since no alternative explanation suggested itself without postulating some entirely new law of Nature, the expanding universe remained as a working hypothesis in the background of most astronomers' minds.

One of the interesting things that these recent war years have brought is the reopening of this question by E. P. Hubble. Is the universe expanding? Is the red shift actually indicative of motion? Or is the framework of the universe static? And if static, what is the explanation of the displacement of all spectrum lines to the red for distant galaxies? Hubble's analysis of all available data based on the assumption that the universe is expanding, necessitates the calculation of a dimming factor due to recession. When correction is made for this in the estimation of distances, he claims that a map results which is not of homogeneous density, which implies an increasing rate of expansion with distance, and therefore an "age" of the Universe totally inadequate. On the other hand when he assumes a static framework for the universe, the analysis of all the data gives a map that shows a linear relation between red shift and distance, and a homogeneity of density. This map has more to commend it than has the former map, and hence the assumption of a static framework appears to be favoured. But, as

various astronomers have pointed out, the weakness of this result lies in the large probable errors of the quantities involved, so that even an apparent divergence of 30 per cent from uniformity of density is not evidence weighty or certain enough to overthrow the Lemaître theory of an expanding universe.

IV

Important advances have been made recently in our understanding of the sources of energy within stars which permit them to radiate energy as they do. Bethe has given an exposition of a cyclical sequence of atomic changes and interactions whose net result leaves a star with fewer hydrogen atoms, but with more helium and the liberation of excess nuclear energy in the form of gamma rays. This is now generally referred to as the carbon cycle and it is too beautiful not to be recorded here, for though published a few months before the war, it has been during the war years that it has become a part of astronomical thinking. Of the six stages, four result from collisions with hydrogen atoms in the deep hot interiors of main sequence stars, and two are spontaneous disintegrations of unstable nuclei.

1. $C^{12} + H^1 = N^{13} + \gamma$
2. $N^{13} \longrightarrow C^{13} +$ positron
3. $C^{13} + H^1 = N^{14} + \gamma$
4. $N^{14} + H^1 = O^{15} + \gamma$
5. $O^{15} \longrightarrow N^{15} +$ positron
6. $N^{15} + H^1 = C^{12} + He^4$

The two positrons rapidly interact with electrons to give rise to gamma radiation. Thus is produced the penetrating radiation, most of which in the course of its progress towards the boundary of the star becomes transformed into the heat, light and ultra violet radiation that pour out from the photosphere. The central temperatures of the cool giant stars are insufficient to maintain this active cycle, but theory can also explain their radiant energy in terms of atomic collisions and transmutations which are, however, non cyclical. Hydrogen, deuterium, lithium, beryllium, boron are slowly transformed into helium and so on. It appears that

elements up to but not heavier than neon may in these ways be synthesized.

If the central regions of the hottest stars are not the crucibles of nature wherein the eighty-two heavier elements are built up, where and under what conditions were they formed? A highly speculative answer is to be formed in an intensely interesting piece of theoretical research carried out during the early years of this war by Chandrasekhar and Heinrich. They have been inquiring under what conditions of nature the basic units of matter—electrons, protons, neutrons, positrons—could be expected to come together to form, in their various proportions, the atoms of all the isotopes of the elements familiar to the chemist. As these elements compose all stellar bodies as well as all things terrestrial, their synthesis is a cosmic problem. They find that such tremendous extremes of high temperature and high density would be required that it is necessary to suppose that all the matter of the known universe was once confined to a volume of radius only about twenty times that of the solar system. Such a sphere drawn around our sun as centre does not now contain a single other star. Yet into such a volume there may once have been packed not only all the thousand million stars of our own galaxy, but all the millions of other galaxies. This is indeed a picture reminiscent of the "giant molecule" of Lemaître. Since stars and galaxies are not now thus packed, expansion must have taken place some time very long ago. The present rate of expansion is such that galactic distances are doubled every 1800 million years. This gives the time elapsed, since the expansion began, as several thousand million years which is in satisfactory accord with the age of the earth as determined by other physical lines of approach and regarded necessarily as a lower limit for the age of the universe.

The last chapter on these cosmological problems is not yet written—indeed there may well be many chapters yet to come and still no last chapter in sight. It is the glory of the quest that as men seek the unexplored horizon the margin fades forever and forever as they move.

V

An investigation of very recent date has led to positive conclusions about planet-like bodies associated with stars other than our sun. There is strong evidence for this in the case of 61 Cygni and 70 Ophinchi. This may be the beginning of a new search and a new certainty in a field of astronomy hitherto theoretical and speculative. Already several astronomers on two continents are studying the implications.

Another astrophysical problem that has been worked upon with considerable success during these war years, is the old back-log problem since 1869 of the solar corona. At Uppsala, Edlén has been examining the X-ray and ultra-violet spectra of some very highly ionized atoms, and a year ago his 1942 paper was received in England and also in the U.S.A. He uses his laboratory data as basis for calculation of forbidden lines and altogether he identifies seventeen coronal lines with lines of Fe X, XI, XIII, XIV, XVr Ni XII, XIII, XV, XVI, Ca XII, XIII, A X; and two othe, lines less certainly with Ca XV and A XIV. The ionization potentials required to produce such atoms are very high, actually 233 volts for Fe X, 655 volts for Ca XIII, and at first this seemed to offer an insuperable obstacle to acceptance of Edlén's proposals. The age-old question of Nicodemus arose—how can these things be? These atoms are many thousand miles from the photosphere of the Sun; and to produce such ionization, temperatures of two million degrees are necessary. Speculation and calculation have followed. A few months ago an explanation was given in a letter to *Nature* by V. Vand of London. Even higher temperatures he shows to be possible in the low density regions of the corona as a result of collisions of high velocity atoms falling towards the Sun from interplanetary space. With the greater density of the inner corona and consequent increase in radiation losses, he believes conditions may be favourable to just those transitions postulated by Edlén.

VI

The numbers 136, 137, 256 will awaken in the minds of many of you memories of a kindled interest, of perplexity, doubt, expectation and perhaps of moments of great thrill, as you think back

over the last ten years. One name alone stands central amongst these memories—that of Sir A. S. Eddington. This has been his playground pre-eminently. Some of us have stood fascinated at the edge of the field watching this illusive game played patiently, skillfully, brilliantly by one man, a master juggler with the elements of the theory of groups, with quantum mechanics, and with the basic units of measurement, producing, as from the proverbial hat, physical constants both atomic and astronomical. Some there have been who paused to watch briefly, to smile or even ridicule the Aristotelian *tour de force*. But steadily and doggedly the theory has been pushed forward, several papers having appeared in the last three years until now the evidence is overwhelmingly great that, with no observational data other than three basic constants, namely, the velocity of light and the Rydberg and Faraday constants for hydrogen, it is possible to calculate theoretically the following thirteen physical constants: charge e; Planck's constant; masses of electron, proton, hydrogen atom; gravitation constant; fine structure constant; nuclear range-constant; nuclear energy-constant; mass of universe; number of particles in universe; Einstein radius of space; nebular speed. This is a striking achievement.

Let us look briefly at just two of these constants. The recessional velocity of the spiral nebulae is calculated to be 572.36 km per second per megaparsec. The observational value of Hubble and Humason is 560. When the great 200-inch reflector comes into action, we shall expect to see the observational value come closer to Eddington's determination.

The number of independent quadruple wave functions at any point is $2 \times 136 \times 2^{256}$ or 3.15×10^{79} and in his earlier work Eddington identified this with the number of particles in the universe. Since 1939 he has found that a question of non-integrability in spherical space necessitates a reduction of 25 per cent; so the number given in his 1942 paper is 2.36×10^{79}.

This theoretical approach has now reached a point where its author can write "I think the theory now deserves to be the accepted theory—my definition of an 'accepted theory' being that it is the theory which is so far right that everyone is interested in trying to discover what is wrong with it." Can we wonder that he

pauses in his work to refer to "the devastating beauty of quantum arithmetic." This entire investigation must surely rank as one of the great adventures of the human mind exemplifying Blake's stately metaphor—"Imagination goes forth in its uncurbed glory."

VII

This brief survey of a few fields of astronomical research, incomplete as it obviously is, will serve nevertheless to indicate that pure science is not dormant, much less is it dead, during the terrible years when the vile demoniacal God of War stands astride the earth. For many years the International Astronomical Union has been an influence for understanding, and for co-operation in the search for knowledge with mutual respect and trust. It is once again temporarily in abeyance, and it will once again rise to carry on it's good work. The lesson of astronomy down the centuries has been one of international interdependence and mutual indebtedness.

The problems facing mankind are very complex,—the dealings of man with man, the attitude of nation to nation. No solutions making for international good will and world peace will be achieved by men of narrow mind, myopic sight and dwarfed soul. The far vision in time and space, the winged imagination that leaps the barrier of here and now—these are the qualities of mind and spirit needed in every walk of life and needed superlatively in the leaders of every nation if in the years just ahead of us progress is to be made towards the great ideal of international unity. How can the eyes of the blind be awakened to the dazzling vision of the City of God? For some it may be by the contagious enthusiasm of a great teacher or leader, for others the illumination from poetry, for some the spark is kindled by the study of history, or of philosophy, and for yet others it is through natural philosophy and astronomy. Mankind needs the perspective of the cosmic background. "The great values," said Field Marshal Smuts, "retain their unfading glory and derive new meaning from a cosmic setting."

There is a challenge to the scientists and to the lovers of science to teach the boys and girls, the young men and women of today and tomorrow, the ideals, the aims, the methods and the integrity of the scientific approach to facts and to problems.

We do not forget the dictum of Rabelais, "Science without conscience is damnation." Wartime drives this home with bitter and tragic intensity. But we may say with great assurance that Science with conscience has an essential part to play in procuring and maintaining world conditions in which peace can endure.

All who have the ideal of world-citizenship at heart, all who have the far vision of things that have been and of things that may be, and the realistic grasp of things that are, must cooperate in the great task of bringing into the affairs of mankind upon this earth some semblance of the order, beauty and harmony of the universe of stars. Towards this end, both directly and indirectly, astronomy and astronomers can play a part; and it may prove to be a part which no one else can play for them because they, the astronomers, are the people with the fullest understanding of the cosmic background.

A. VIBERT DOUGLAS

Queen's University
Kingston, Ontario.
Jan. 21, 1944.

REVISED CONSTITUTION AND BY-LAWS OF

The Royal Astronomical Society of Canada

ADOPTED BY THE ANNUAL MEETING, JAN. 18, 1944

CONSTITUTION

Article I. Name

The Society shall be called the Royal Astronomical Society of Canada.

Article II. Headquarters

The Executive Headquarters of the Society shall be located in the City of Toronto.

Article III. Objects of the Society

The objects of the Society shall be:

(*a*) To study Astronomy, including Astrophysics, Geophysics and such cognate subjects as shall be approved by the Society; and to diffuse theoretical and practical information with respect to such subjects.

(*b*) To publish from time to time the results of the work of the Society; and

(*c*) To acquire and maintain a Library and other property which may be desired for carrying into effect the objects of the Society.

Article IV. Officers of the Society

The officers of the Society shall consist of an Honorary President, a President, a First Vice-President, a Second Vice-President, a General Secretary, a General Treasurer, a Librarian and a Recorder.

Article V. General Council, Executive Committee

The Officers, the Editor (chosen according to By-law X), and twelve additional elective members, together with the two immediate past Presidents, and the elected presiding officer for each Centre organized as hereinafter provided for in Article VII, shall form the General Council which shall have general charge of the affairs of the Society.

No member shall be eligible for election to the same office, or as an elective member, of the General Council at more than three consecutive annual elections, provided however that this limitation shall not apply to the offices of General Secretary, General Treasurer and Librarian.

In order to carry on the routine business of the Society or to meet any emergency which may arise when the General Council is not in session, there shall be an Executive Committee consisting of the President (who may delegate some member of the General Council to act in his stead), the General

Secretary, the General Treasurer and two other members of the General Council to be chosen at its first meeting of the year. Any action taken during an emergency shall be reported at the next meeting of the General Council and shall be specified in the notice calling such meeting. The quorum of the Executive Committee shall be three.

Article VI. Election of General Council

The Officers named in Article IV and the twelve additional elective members of the Society who serve on the General Council shall be elected at the Annual Meeting of the Society.

An official ballot paper shall be mailed to each member of the Society one calendar month prior to the Annual Meeting. Each such ballot paper shall contain one or more names proposed by the General Council for each vacancy, as well as the names of any who may have been nominated by five members in good standing at least two weeks before the issue of the ballot papers; with blank spaces in which the voter may substitute other names; and, to be valid, the envelope containing the ballot must, when returned, bear the signature of the voter and must be received by the General Secretary before the time of closing the poll at the Annual Meeting.

In case of an equality of votes for any office the members present at the Annual Meeting shall choose between the two candidates having the highest number of votes.

Should an office for any reason become vacant or should any elected member of the General Council die or resign before the expiration of his term, the vacancy for the unexpired portion of the term shall be filled by vote of the General Council.

Article VII. Centres of the Society

When at any place or within any area in Canada a sufficient number of members of the Society desire to organize a Centre of the Society for the purposes stated in Article III, and to hold meetings thereafter, the General Council, upon the request of the said members, may authorize the formation of such a Centre.

The governing body of each Centre shall adopt its own constitution and by-laws which shall be in conformity with those of the Royal Astronomical Society of Canada and shall be submitted to the General Council for its approval.

Each local Centre shall be under the control of the General Council, which shall make an annual appropriation for its use and benefit. The meetings of the Centre shall be known as Meetings of the Royal Astronomical Society of Canada.

A Centre may own a library, an observatory, instruments or other property; and the Centre alone shall be responsible for its property.

ARTICLE VIII. AMENDMENTS TO CONSTITUTION AND BY-LAWS

The Constitution of the Society may be amended at the Annual Meeting; and due notice of any proposed amendment must, after authorization by a majority of the General Council, be sent to every member of the Society at least one calendar month before the date of voting. Such amendment to be adopted must receive at least two-thirds of the votes cast (in person or by mail). The said vote shall be enclosed in an envelope bearing the signature of the voter and must be received by the General Secretary before the counting of the votes at the Annual Meeting.

When any important measure affecting the policy or welfare of the Society is presented to the General Council, supported by five of its members or five members of the Society in good standing, such measure shall be submitted by mail to every member of the General Council for action thereon; and a majority vote of the members of the General Council shall be necessary to secure the recommendation or adoption of such measure.

All amendments to the By-laws shall be subject to the same conditions as those governing changes in the Constitution, but they may be made not only at the Annual Meeting but at any time when found expedient.

BY-LAWS

I. MEMBERSHIP

The membership of the Society shall comprise two classes:

(1) MEMBERS, including a sub-class of JUNIOR MEMBERS; and

(2) HONORARY MEMBERS.

Persons may be elected Members as provided in By-law II(*a*) or (*b*), printed below. They shall be listed either as attached to the local Centre of their choice, or as Unattached Members. Members making application in writing may be transferred by the General Council from one list to another.

Junior Members shall be limited to

(*a*) Full-time students at any educational institution,

(*b*) Other persons under twenty-one years of age.

The manner of their election, their fees (subject to the provisions of By-laws IV and XIV) and their privileges shall be determined entirely by the Council of the Centre to which they are attached. Junior Members shall have no votes at any Society election.

Honorary Members shall be selected in recognition of scientific attainments of the highest order. They shall be chosen as prescribed in By-law III. At no time shall there be more than fifteen Honorary Members. Provision for an Honorary Prsident is made in Article IV of the Constitution. Honorary Members shall pay no fees and have no votes.

II. Election of Members

(*a*) *Election of Members and Junior Members attached to Local Centres.* Persons desirous of being proposed for membership shall be recommended by at least two members of the Society of a Local Centre. The proposal and recommendation shall be read at a meeting of the Local Centre of which the candidate seeks membership in the Society, and the election may take place at that or any subsequent meeting thereof. To be elected, the candidate must receive at least two-thirds of the votes of the members present, whereupon he, or she, shall become a mmber of the Society and shall be attached to the Local Centre at which he, or she, has been elected.

(*b*) *Election of Members unattached to any Local Centre.* Persons desirous of being proposed for membership in the Society, but without being attached to a Local Centre, shall be recommended by at least two members of the Society. The proposal and recommendation shall be read and election shall take place at any meeting of the General Council. Voting shall be by ballot; and, to be elected the candidate must receive at least two-thirds of the votes of the members of the General Council present at the meeting thereof.

(*c*) Upon payment of fees, the Treasurer of the Local Centre in the case of members and the General Treasurer in the case of members unattached to any Local Centre shall supply the newly elected member with a copy of the Constitution and By-laws of the Society. The Treasurer of the Local Centre shall forward to the General Treasurer the name and address of each new member as soon as his fees are paid.

Every candidate elected to membership shall pay his, or her, fee within sixty days of election, otherwise the election shall lapse and be void.

The General Council shall, upon a two-thirds vote of those present at a lawful meeting of the General Council, have power to remove from membership in the Society any member whenever in its opinion the best interests of the Society shall seem to require such removal.

III. Election of Honorary Members

Honorary Membership may be conferred as a recognition of scientific attainments of the highest order. Nominations for Honorary Membership shall be made to the General Council by a standing committee consisting of the President (chairman) and the two immediate past Presidents at its meeting in the autumn to nominate members of the General Council for the following year. The reasons for bestowing the honour shall be given in writing by the chairman of the committee. Not more than two Honorary Members may be proposed during any calendar year except on request signed by not less than two-thirds of the members of the General Council. For election, a majority of the votes of the members of the General Council, present or voting by mail, must be favourable. No person shall be elected an Honorary Member without his previously-expressed acceptance of the proposed honour.

IV. Fees

The annual fee of a Member shall be payable on the first day of January in each year. The fee shall be two dollars per annum. If the Member is elected before the first day of September the full fee shall be paid; if after that date, one half.

Any Centre desiring the Journal and the Handbook of the Society for its Junior Members shall remit one dollar per year per member to the General Treasurer.

Any Member at any time, all sums then due being first paid, may make a single payment of twenty-five dollars and become a life member. The Society at an Annual Meeting, on recommendation of the General Council, may confer life membership on any Member in recognition of services rendered.

When a Member is one year in arrears in payment of his annual fee the General Council may erase his name from the membership roll.

V. Meetings of General Council

The General Council shall meet at the Society's Executive Headquarters, on the call of the President. In his absence, or in case of his refusal to act, any three members of Council may issue, or cause to be issued, notices for an emergency meeting. The notices shall state clearly the reasons the councillors have for calling the meeting; and no other business shall be transacted at such meeting than that of which specific notice has been given.

None other than routine or necessary business may be transacted at a meeting of the General Council unless it shall have been explicitly listed in the agenda in the notice calling the meeting. Such notice shall be mailed from headquarters at least fourteen clear days before the date of the meeting, and the notices to members of Council living more than a thousand miles away shall be sent by the fastest form of post. The quorum of Council shall be five.

There shall be two fixed periods for meetings of the General Council: (1) Between 1st and 15th February; and (2) between 1st and 15th November.

VI. The President

It shall be the duty of the President to take the chair at the meetings of the General Society and of the General Council; and in his absence one of the Vice-Presidents or other authorized member shall act in his stead. The President shall not vote at any meeting of the Society or Council, except where a casting vote is necessary to decide a question, in which case he shall give such casting vote.

The President shall ex-officio be a member of every committee of the General Council, and may vote as such member unless he is in the chair, when he shall only exercise the right of giving if necessary a casting vote.

VII. The General Treasurer

It shall be the duty of the General Treasurer to receive all moneys due to the Society, to keep all books pertaining to his office, to make all payments, to prepare the cash and balance sheets and have them duly audited, and generally to act under the instructions of the General Council. He shall make no payment on behalf of the Society unless such payment is first authorized by the Council. He shall, on receipt, deposit to the credit of the Society, in some chartered bank approved by the Council, all moneys which come into his possession as such Treasurer. He shall pay only by cheque, signed by himself and countersigned by another officer appointed by Council.

VIII. The General Secretary

It shall be the duty of the General Secretary to conduct the official correspondence of the Society and to report such to the General Council at the first meeting thereafter; and to issue notices calling meetings of the General Society or of the General Council as required.

IX. The Recorder

It shall be the duty of the Recorder to keep accurate minutes of the meetings of the General Society and of the General Council. As soon as possible after each meeting of the General Council he shall send to each of its members a full report of the minutes of such meeting. A record of the minutes of the General Council shall be kept at the Library of the Society.

X. Editor and Editing Committee

The General Council may appoint an Editing Committee of three members, one member of which, to be designated by Council, shall be the Editor. The committee, at the commencement of each year, shall submit a budget of proposed expenditures for that year, and at the end of the year shall make a report to Council of all disbursements.

XI. The Librarian

Subject to regulations approved by the General Council, the Librarian shall have charge of and be responsible for the safe-keeping and proper condition of the books and publications, maps, photographs, and like property of the Society. He shall report the names of publications, donations, etc., received. He shall also have charge of the Exchange List of the Society, and shall oversee the distribution of the Society's publications. The Librarian shall also have charge of any instruments or apparatus possessed by the Society. He shall see that the rules governing the issue and return of books are obeyed, and that any property of the Society which may be loaned shall be returned at the time agreed upon and that any injury to it shall be made good.

XII. Board of Trustees

A Board of Trustees shall be appointed by the General Council, consisting of three members including the General Treasurer (as Chairman), for the purpose of administering the special funds of the Society and the investment of such funds. This Board shall also have charge of any real property of the Society; and shall make a report of its transactions to the Annual Meeting of the Society.

XIII. Annual Meeting and Common Seal

The Annual General Meeting of the Society shall be held between the 1st and the 20th day in January in each year. At this meeting the officers of the Society shall make reports of all their acts during the year.

The Society shall have a common seal approved by the General Council of the Society.

XIV. Regulation Relating to Centres

The annual meeting of each local Centre shall be held before the fifteenth day of December in each year. At this meeting the reports of the Secretary and the Treasurer, duly audited, on the work of the Centre for the year shall be considered; and after approval by the meeting they shall be transmitted to the General Secretary in time to reach him before the 31st day of December.

The fees collected by the Local Centre (except those from the Junior Members) are payable to the General Treasurer. All such fees shall be remitted so as to reach the General Treasurer not later than December 20th of any calendar year.

MINUTES OF THE ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The Annual General Meeting of the Royal Astronomical Society of Canada was held in the McLennan Laboratory on Tuesday evening, January 18, 1944. In the absence of the President, Dr. A. E. Johns, First Vice-President, occupied the chair.

In the absence of the Recorder, Dr. D. W. Best was asked to act as Recorder pro tempore.

Minutes. The Minutes of the 1943 Annual Meeting having been published in the JOURNAL, on motion of Messrs. E. J. A. Kennedy and C. A. Crook it was agreed that they be taken as read and approved. On motion duly seconded it was agreed that Mr. C. A. Crook, Miss E. M. Budd and Mr. T. E. Coupe be appointed to act as scrutineers.

General Treasurer's Report. Mr. J. H. Horning presented the report of the General Treasurer and after commenting on various items of it, moved, seconded by Mr. J. R. Collins, that it be adopted. It was so agreed. The Report in detail is printed elsewhere in this number of the JOURNAL.

General Secretary's Report. Mr. E. J. A. Kennedy presented the Report of the General Secretary (which appears elsewhere in this number of the JOURNAL) and moved, seconded by Miss Ruth J. Northcott, that this report and with it the reports from the various centres be received and adopted. It was so agreed.

After some informal discussion it was moved by Dr. Best, seconded by Mr. Troyer, that the General Council be asked to take into its consideration the cost of the publications of the Society in relation to the prices asked for these and in its wisdom to recommend what changes, if any, should be made. It was so agreed.

On motion of Mr. E. J. A. Kennedy, seconded by Mr. J. H. Horning, it was agreed that the matter of publicising the competition for the Chant Medal be referred to the General Council for its consideration and action.

Attention having been drawn to the lack of uniformity in reports of Treasurers of Centres, it was agreed on motion of Messrs. J. H.

Horning and E. J. A. Kennedy that this matter be brought to the attention of the General Council for its consideration.

On motion of Messrs. E. J. A. Kennedy and J. H. Horning it was cordially agreed that the thanks of the Society be tendered to the Auditors, Mr. Andrew Thomson and Mr. H. W. Barker, for their valuable services, and that they be re-appointed for the ensuing year.

Report of the Librarian. In the continued absence of Dr. Millman on war service the report was presented by Dr. D. W. Best, Acting Librarian, who moved, duly seconded, that the report be received and adopted. It was agreed. On motion of Messrs. G. T. Dale and J. H. Horning it was agreed that the Librarian be asked to compile a list of recent books added to the library, the list to be published in the JOURNAL. It was moved by Mr. Kennedy, seconded by Mr. Crook, that the Acting Librarian, with Miss Fuller and Mr. J. R. Collins, be appointed to make a valuation of the books, publications and other property in the care of the Librarian at 198 College St. and of the books on loan to the David Dunlap Observatory and to report the result of their work to the General Council. This motion was carried.

Curator. Mr. R. S. Duncan presented the report of the Curator, and moved that it be adopted. It was so agreed.

Scrutineers' Report. The Scrutineers reported that 330 ballots were received, that the list of Officers and Members of Council were favorably voted for and they were accordingly declared elected and ordered to be recorded. There were 321 votes for the Revised Constitution, and two against. The Revised Constitution was accordingly declared adopted. (See pp. 101-107.)

On motion of Messrs. Dale and Crawford it was agreed that a hearty vote of thanks be tendered to the Officers for their work during the past year.

The meeting then adjourned.

D. W. BEST, *Recorder pro tem.*

REPORT OF THE GENERAL SECRETARY FOR 1943

The membership of the Society again shows a very splendid increase. Our experience during the last war, when our membership fell off sharply, prepared some of us for a similar slump, but

history did not repeat itself in this case. It is therefore all the more gratifying to report that for the two years 1942-1943 the percentage of increase has been almost thirty. No doubt the requirement of the Air Force for a knowledge of the stars by pilots and navigators has been partly responsible. This has made the general public more conscious of the science of astronomy, and the great assistance our Society and members can be in a time like this. However on analyzing the figures you will notice that Montreal and Quebec City contribute largely to the good showing. The Montreal Centre has been particularly successful in its campaigns and is to be congratulated. Montreal listed eighty members in 1931—this year 257. A knowledge of its membership campaign committee plans would be a great help to other Centres.

We regret to record the passing of our last Honorary Fellow—Professor Frank Schlesinger of Yale University, and also our Honorary President, Hon. Duncan McArthur, during the year 1943. We also deeply mourn the death of Mrs. C. A. Chant, who was much loved by so many of the members of our Society.

The fourth award of the Chant Medal has been won by Mr. Cyril Geoffrey Wates of Edmonton. This award was established in 1940 to stimulate and foster the interest of the amateur in astronomy and kindred sciences. The contest has met with fair success. We would urge that the Centres publicize the details and importance of this award continuously during the year so that the desires of the Council may better be fulfilled. A number of our members have had special mention in the last annual report of the A.A.V.S.O. for excellent work in the observation of variable stars.

The demand for the Society's publications is continuing, especially the Observer's Handbook; many letters of commendation come in to the office from time to time. A letter from Professor Van Arnam just to hand says, "The Observer's Handbook alone is well worth the modest annual fee. I have used the little book in my teaching and observing more than any other single publication."

The Centres are to be congratulated on the more extensive and interesting reports being sent in; a reading of these reports indicates a greater interest in the affairs of the Society generally.

A year ago the General Council appointed a committee to study

the 35-year-old Constitution with a view to proposing amendments made desirable by the increasing growth and greater importance of the Society. This committee presented its report, which was approved by the General Council at its meeting November 5 last. Ballots were sent to all members of the Society and the election at the Annual Meeting resulted in the adoption of the amended Constitution by 321 votes in favour, with two against.

E. J. A. KENNEDY, *General Secretary.*

MEMBERSHIP ON DECEMBER 31, 1943

	1942	*1943*
Toronto Centre	191	208
Montreal "	146	257
Winnipeg "	36	29
London "	38	40
Edmonton "	46	58
Hamilton "	43	43
Vancouver "	31	46
Ottawa "	58	58
Victoria "	93	105
Quebec "	59	70
Members at Large	235	210
Life Members not in Centres	15	14
	991	1,138
Additional subscribers to JOURNAL	41	50

REPORT OF THE LIBRARIAN

During the year 1943 periodicals were received:

From Canada and the Empire	29
" the United States of America	85
" Other Countries	18
Total	132

The number of books loaned from the shelves during the year 126

Expenditure during the year was:

For New Books	$24.50
For Binding	23.87
Total	$48.37

The following new books were added to the Library in 1943:

The Story of the Moon by Clyde Fisher.
Astronomy, Maps and Weather by C. C. Wylie.
Time and Timekeepers by W. I. Milham.
Foundations of Astronomy by W. M. Smart.
Atoms, Stars and Nebulae by L. Goldberg and L. A. Aller.
Ways of the Weather by W. J. Humphreys.
Yankee Star Gazer by R. G. Berry.
Learning to Navigate by P. V. H. Weems and W. C. Eberle.

The last two were ordered at the same time with the others but at this date have not been received from the publishers.

The Astronomical Society of the Pacific presented a bound volume, "Leaflets—Astronomical Society of the Pacific," Vol. III, 1943.

Mr. N. F. Wright, of Miami, Oklahoma, U.S.A., presented to the Library a set of five volumes of "Boss General Catalogue of Stars for the Epoch of 1950." This gift is found valuable and convenient at the David Dunlap Observatory where its usefulness is fully appreciated.

These gifts are here acknowledged with warm appreciation.

P. M. Millman, *Librarian*,
per D. W. Best, *Acting Librarian*.

REPORTS OF THE SECRETARIES OF THE CENTRES

Toronto Centre

Meetings. During the year 1943 there were held 4 Council meetings and 11 regular meetings. Four summer outdoor meetings were planned for, but unfavorable weather interfered with two of them.

The subject and speaker for the regular meetings were as follows:

February 2—Captain G. D. Frewer: "Astronomy as Used in Navigation."
February 16—Professor John Satterly, Dept. of Physics, U. of T.: "The Age of the Earth."
March 2—Dr. D. W. Best: "The Galaxy."
March 16—Dr. A. M. Crooker, Physicist, Research Enterprises Limited: "Military Telescope Making."
March 30—Dr. A. E. Johns, McMaster University: "Order Is Heaven's First Law."
April 13—Professor E. S. Moore, Dept. of Geology, U. of T.: "The Constitution of the Earth as a Geologist Sees It."

May 24—A meeting in commemoration of the Quadricentennial of the death of Copernicus. An address on the "Work of Copernicus" was given by Professor F. S. Hogg.

June 11—Open Air Meeting.

July 9—Open Air Meeting.

August 9—Open Air Meeting.

September 6—Open Air Meeting.

October 12—W. G. Colgrove, M.A., B.D., London Centre, Chant Medallist 1942: "Some New Aids in Teaching Astronomy."

October 19—W. E. Knowles Middleton, M.Sc., Meteorological Office: "Subsequent History of the Barometer"; Professor John Satterly, Dept. of Physics, U. of T.: "The Applications of the Barometer in Physics and Chemistry." This meeting was in collaboration with the Royal Meteorological Society, Canadian Branch, and other organizations. It commemorated the Tercentenary of the Invention of the Barometer.

November 9—Geo. E. Campbell, M.A., Hamilton Centre: "Astronomical Paradoxes."

November 23—S. G. Ellis, B.Sc., M.A., Dept. of Physics, U. of T.: "Meteorology."

December 7—Dr. F. Shirley Jones: "Counting the Stars."

At each of the spring meetings Dr. Helen Sawyer Hogg carried on a series of short lectures on "Major Advances of the Twentieth Century in Astronomy" and at each of the autumn meetings a series of short lectures on "Fundamentals of Astronomy" was given by Miss Ruth J. Northcott.

Unfortunately, on two of the four evenings for which out-door meetings were planned the weather was so unfavorable as to make observations impossible. On the other two evenings there was a large attendance—from 150 to 200 persons being present during most of the time until closing. Three telescopes were set up each evening and while waiting for their turn the visitors were handed a folder on which was given the dates of the out-door meetings, a brief paragraph about each, the objects to be viewed, a brief statement about the R.A.S.C. and a form of application for membership. Much interest was shown and a number of new members were received as a result of these meetings.

The members also were privileged to participate in the meeting sponsored by the University of Toronto on April 26 as a "Copernican Memorial," the meeting being addressed by Professor Oscar Halecki.

Membership. As of December 31, 1943, there are 208 members on the roll, of whom 10 are life members. There were 40 new members elected and 23 removed for various reasons, leaving a net gain of 17.

TRACY D. WARING, *Secretary.*

OTTAWA CENTRE

The activities of this Centre for the past year have covered a wide area, though it cannot be said that they have been unusually vigorous in any direction, which is due to the absence in the forces of some of our most active members and to the fact that so many of the officers and members are so busy with extra work and duties.

As regards public lectures, only one was held in the past year, and it was a decided success. This meeting was held on April 9 in the Museum Hall; Dr. A. V. Douglas, President of the Society, lectured on Copernicus to a large and interested audience. This Centre's valued co-operation with the Chemical Societies of the city has continued, and each has specially invited the members of the other to its lectures.

The Junior Club carried on again last winter under the tutelage of Miss Burland and Messrs. Morwick and Bradley. In form and method it remains much as formerly, and with quizzes, contests, etc., makes sound use of the competitive spirit of youth. It has its own officers, and continues to show promising interest and enthusiasm, and as before was kindly permitted to hold its meetings at the Observatory.

By using every opportunity to make known the merits of the R.A.S.C. Handbook, this Centre managed to distribute and unusually large number. Quite apart from those regularly received by Society members, 105 Handbooks were sold here this year.

This Centre's most sustained and successful efforts have been demonstrated in the weekly column in the Citizen known as "Sky Facts." Entirely made up of contributions by members of the Centre, it grows continually in popularity. A large number of enquiries, as well as many remarks made to members, testify to the interest it arouses, while its regular use in R.C.A.F. stations, schools, etc., testify likewise to the service it performs.

The Executive held two regular meetings and one special meeting during the year; the latter concerned questions of constitutional amendment and decided this Centre's standing thereon.

F. W. MATLEY, *Secretary.*

HAMILTON CENTRE

During the year the Hamilton Centre held eight regular meetings and one Field Night consisting of the following:

January 7—Mr. D. G. Burns: "An Abstract Expanding Universe."

February 4—Mr. J. R. Gibbs: "Thunder and Lightning."

March 4—Dr. H. G. Thode: "Nuclear Chemical Reactions in the Sun."

April 1—C. F. Marshall, B.A.: "Atomic Structure."

May 6—Dr. A. E. Johns: "Order Is Heaven's First Law."

June 9—Field Night: Held at the W. T. Goddard Observatory; many telescopes of both reflecting and refracting types were set up for the use of the members and their friends.

October 7—W. D. Stewart, B.A.: "Ocular Lenses." H. B. Fox gave a very practical demonstration of "Telescope Mounting" and had patterns of same on display. Dr. A. E. Johns and G. E. Campbell, M.A.: "A Pedagogue Parody."

November 4—Prof. N. H. Parker: "Babylonian Discoveries in Astronomy." F. H. Butcher, B.A.: Illustrated talk on "Paleontology."

December 2—T. M. Norton: "Are Other Planets Inhabited?" This was the annual meeting for the election of Officers.

The meetings throughout the year were educating as well as entertaining; chairman H. B. Fox as usual rounded up a good selection of speakers both for the main lecture and the curtain raisers.

The paid-up membership to date is 43.

JAMES R. GRAHAM, *Secretary-Treasurer.*

MONTREAL CENTRE

On the 28th of May, 1918, Messrs. James Weir, Mgr. C. P. Choquette, Lt.-Col. W. E. Lyman, George Sample, John Conway, the Rev. W. T. B. Crombie, and M. A. Kingsbury met in the Engineering Building of the McGill University, and organized this Centre of our Society. Our gathering here tonight thus closes the twenty-fifth year of this Centre's activities.

It is gratifying to be able to report that our numbers have increased

but more gratifying to note the interest of our members as evidenced by the large attendances at our meetings as well as at the observation periods at the Ville Marie Observatory.

During the past year the introductory course of lectures was delivered by the members of the Society, in addition to which two meetings were devoted to the showing of moving pictures, and on another occasion we were fortunate in being addressed by Mr. F. J. Mahaffy, the Meteorologist at the Dorval Airport. The Sigma Xi Society was kind enough to invite our members to hear a lecture on Copernicus given by Dr. Vibert Douglas.

Our Telescope Committee under the leadership of Mr. Garneau has done most excellent and commendable work and can properly be described as a live-wire organization. It is regrettable that our new 12-inch reflecting telescope was proved to be hyperbolic. This defect will be remedied when circumstances permit.

Mr. Duffie, our Librarian, has reported to you additions made to the Library and I am happy to be able to say that the Library was extensively used. Our finances under Mr. de Kinder's guidance are sound.

Although he has been prevented by illness and overwork from attending our lectures, Dr. A. Norman Shaw, the Director of the Physics Department, has watched our progress. We are grateful to him that this theatre has been at our disposal. Mr. Lane as usual has seen to it that all requisite details have been looked after.

DAN P. GILLMOR, *President.*

The Report of the Librarian of the Montreal Centre, Mr. J. W. Duffie, includes the following information: During the year the Library was moved to the Ville Marie Observatory, 4052 Wilson Avenue, where members of the Telescope Committee are in attendance every Saturday evening. This has resulted in an increase in the number of books circulated, and while no exact figures are available due to the affairs of the Library having passed through several hands, we usually have from twenty to twenty-five books out on loan. A new record system has been installed, which will provide accurate statistics in the future.

Through the kindness of Mr. Garneau, who has offered to do the

heavy work of transporting the books, we intend to continue the practice established last year of bringing some of the books to each meeting for the convenience of members.

The Library now contains ninety-one books, including fifteen in the French language, as well as numerous periodicals, reprinted articles, etc. We also have complete files of the Society's Journal for the years 1925 to 1942.

In order to insure a fair distribution of the books, it has been decided to set a time limit of one month on books borrowed. If further time is required, the borrower may obtain a renewal for a further period of one month, provided no other requests have been received for the book.

J. W. DUFFIE, *Librarian.*

The Report of the Telescope Committee, by Mr. Delisle Garneau, records 41 telescope meetings held at the Ville-Marie Observatory, with a total attendance of 415 compared with only 120 the previous year.

Ten observational activities are listed, including magnitude estimates of Nova Puppis; a total of 535 observations of variable stars in collaboration with the A.A.V.S.O.; observations of the Perseid meteors; systematic nova search; lunar eclipse observations, and a program of Aurora Borealis studies.

[The members of the General Council and the Editors are greatly impressed with the number of members of the Montreal Centre taking part in these active programs. Certain of the observations have already been published, and others will be published later.]

LONDON CENTRE

During the year 1943 the London Centre held eight regular meetings and one special meeting. The program of each meeting included a discussion of the Observer's Handbook and a report on Current Topics. In addition, Dr. H. R. Kingston presented a series of lectures which constituted a Survey Course in Descriptive Astronomy. Other details of the separate meetings follow.

January 15,—Public meeting at the London Public Library.
Rev. W. G. Colgrove and Dr. H. R. Kingston: "Demonstration of Astronomical Instruments."

February 5,—Mr. F. L. Taylor: "Weather Forecasting."

March 5,—F/Lt. J. D. Goodge: "Navigation by the Stars."

April 2,—Dr. E. G. Pleva: "The Significance of the Polar Regions in Long Distance Flying."

May 7,—Mr. G. H. Reavely: "Fluorescent Rocks."

June 11,—Dr. J. A. Pearce, Dominion Astrophysical Observatory: Special meeting preceded by a dinner in the University cafeteria. "The Rotation of the Milky Way."

October 1,—Rev. W. G. Colgrove: "The Universe and its Stars."
Sound Films: (1) The Moon; (2) Exloring the Milky Way.

November 5,—Mr. A. Emsley: "Copernicus—the 400th anniversary of his death."

December 3,—Annual Meeting. Reports and election of officers.
Rev. W. G. Colgrove: "The Christmas Star."
Entertainment and refreshments.

The total attendance for the year, excluding the annual meeting, was 298.

The paid up membership on this date is 41.

R. H. COLE, *Secretary*.

VICTORIA CENTRE

Membership. During the year 1943 our membership has increased by 4 members, 19 new members having enrolled, and 15 members having been lost to the Centre for the following reasons: 1 deceased, 5 resigned and 9 dropped for non-payment of dues. The present total membership is 105, made up as follows: Life members 3, Junior members 5, regular members 97; total 105.

Meetings. Seventeen meetings were held during the year, including 7 general meetings, 5 Council meetings and 5 Summer Course meetings. General meetings commenced with the Annual Dinner of December 16th, 1942, and continued with 6 lectures. Council meetings were held to carry on the business of the Centre.

Summer Course. The summer course, consisting of 3 lectures and 2 outdoor meetings, was marked by an increase both in attendance and enrollment. Thirty-one members enrolled, and the attendance of 60-100 was maintained throughout the course.

Conclusion. A varied programme, with lectures of an unusually high standard, and the keen interest of our growing membership have made 1943 a most successful year. It is hoped that the coming year may bring continued success to this Centre.

MIRA V. YARWOOD, *Secretary*.

Vancouver Centre

During 1943, seven regular meetings of the Centre were held in Room 200 of the Science Building of the University of British Columbia. An excellent programme of addresses on interesting topics was enjoyed by members and their friends during the year. The following is a list of speakers and their subjects:

January 12,—W. Petrie, Ph.D.: "The Moon" (substituting for Dr. J. A. Harris, who was ill).
February 9,—W. Petrie, Ph.D.: "New Theories of the Solar Corona."
March 9,—Capt. R. F. Bovey: "Adjusting Ships' Compasses."
April 13,—K. O. Wright, Ph.D.: "The Constitution of the Stars."
October 12,—W. Petrie, Ph.D.: "Planetary Nebulae."
November 9,—Lt.-Commander C. A. McDonald, R.C.N.R.: "Straight Lines and Circles in Navigation."
December 14,—R. M. Petrie, Ph.D.: "Moving Star Clusters."

The meetings were well attended, and invariably enlivened by spirited discussions at the close of the lectures. Monthly notices to the regular meetings were mailed to approximately 55 persons.

H. D. Smith, *Secretary.*

Edmonton Centre

Two Council meetings were held during the year to arrange the programs, and to transact other essential business. Seven regular meetings have been held in the Arts Building through the courtesy of the University authorities. Of special note was the official opening of the new Observatory in May. The annual dinner meeting was held in the Corona Hotel. The average attendance was 32 members and visitors (the same as last year).

The Handbook talks during the year were given by Mr. Wates and Dr. Campbell. Short talks on the constellations and other astronomical sidelights were given by the secretary assisted by various members.

The main speakers and their subjects were as follows:

December, 1942,—Mr. E. S. Keeping: "Isaac Newton."
January, 1943,—Mr. H. B. Collier: "Meteorites."
February,—Adjourned to the Observatory for Observation.
March,—Mr. A. Stockwell: "Co-ordinate Systems."
Dr. J. W. Campbell: "The Astrolabe in Use."

April,—Miss Jean Wallbridge: "Saturn."
May,—Mr. L. H. Nichols: "Copernicus, 400th Anniversary."
October,—Mr. H. E. Zinkan: "Latitude and Longitude."
November,—Mr. Max Wyman: "The Tides."

Several observation nights for members and their friends have been held at the Observatory, through the kindness of Mr. Wates and Dr. Campbell. The roll of the centre consists of 55 regular members and 7 associate members.

E. H. GOWAN, *Hon. Sec.*

The Report of the Librarian of the Edmonton Centre: During the year three books of the series of Harvard Books on Astronomy have been added to the library. The Librarian desires to record with thanks the gift of two books to the library. A copy of Moulton's "Consider the Heavens" was donated by Mr. T. W. Hamilton in memory of the late Mr. W. H. Plumb, a charter member of this Centre. Mr. C. G. Wates also presented a copy of Bazley's "Stars in their Courses," an atlas of the constellations.

The Centre has continued its subscription to "The Sky," back numbers of which, right back to no. 2 of vol. 1, are on file.

The library has been used fairly regularly by a few of the members, but not as widely as might be hoped.

The small bookshelf which accommodates our library is beginning to be inadequate. Next year the Centre will probably have to consider providing an extension.

E. S. KEEPING, *Librarian.*

QUEBEC CENTRE

The most noticeable event of the year, at the Quebec Centre, was undoubtedly the recognition, in some sense, by the Provincial Government of the intensive work carried on by our organization in the way of re-establishing astronomy in Quebec city. On September 1st, indeed, the writer was appointed to take charge of the observatory of the Centre, with the intention that he should devote all his time to astronomical work. As a consequence of the Government aid, the maintenance of our temporary observatory is now secured and its material development becomes possible.

During the year 1943, the Centre held regularly its monthly meetings, except in the summer months, but at only a few of them were formal addresses given. Here are the titles with date and author:

February 5,—Professor H. Paul Koenig: "Le test de Foucault."
March 19,—M. Lucien Pouliot: "Le télescope de 200 pouces du Mt Palomar."
November 24,—Professor M.-Louis Carier: "Quelques notions de mécanique céleste."

Besides these regular meetings, the Quebec Centre took part in the organization of public meetings and "star parties." First, on May 23, jointly with Laval University, we held in the Salle des Promotions of this institution a ceremony commemorating the quadricentennial of Copernicus. The two leading addresses were delivered by Abbé André Krzesinski, of the University of Krakow, and by Dr. Christian Lapointe, professor of Physics at Laval University, who respectively developed the subjects: *Copernicus, the Humanist,* and *Copernicus, the Astronomer.* A few pieces of Polish music were played, during the intermissions, by a young pianist of the city.

On June 11, three of our members motored to the city of Shawinigan Falls, bringing with them a portable 4-inch refractor and the astronomical film, "The Universe as seen through the largest telescopes." They were invited by the members of the R.A.S.C. living in that city to give a repetition of our open air meeting of last year, in order to learn how much the citizens were interested in astronomy. Before the representation of the films, the Chanoine Hervé Trudel, who kindly consented to preside, said some words of welcome to the 300 persons present and to the visitors from Quebec. He was followed by Mr. Jocelyn Smith and M. Lucien Pouliot, the latter speaking in the name of the Quebec party. From 9 o'clock to 11, opportunity was given to view the moon and some double stars, through a 6-inch reflector equipped with a Springfield mount, personally constructed by Mr. L. McWilliams, of Shawinigan Falls, and our 4-inch refractor.

Another out-door party was organized on July 13, this time in the woods near St. Etienne de Lévis, for the special pleasure of a group of Girl Guides of the city camping at this place.

The membership increased from 59 to 70 during the year. This increase is partly due to weekly articles published in a local newspaper. Contributions from members permitted the series to be continued without interruption.

The observatory of the Centre, which is located on the historic

Plains of Abraham, was considerably improved during the year, but the work planned is not yet completed. Our programme of observational work was kept up all through the year but only with one regular observer; his chief result was the estimation of the brightness of 1400 variable stars. Systematic work on Mars with the 16-inch reflector was considerably hindered by bad weather during the last three months. On the rare occasions when the sky was clear, strong winds rendered the observations quite impossible. As usual, visitors were admitted to the observatory during the first hour in the evening (between 8 o'clock and 9 in winter); 500 signed our guest book, but many more have had the opportunity of looking through our instruments. Among them were strangers from all parts of Canada, and from countries far away such as England, Australia, New Zealand, etc., most of them men of the armed forces visiting the city. Perhaps these visitors were more attracted by the old Martello Tower than by the observatory built on the upper platform. But, in general, they showed much interest in the objects of the sky and in the work we are performing on our instruments.

PAUL H. NADEAU, *Secretary.*

FINANCIAL STATEMENTS, 1943

I. GENERAL TREASURER

GENERAL ACCOUNT No. 4359

Cash in bank December, 31, 1942		
General Account	$610.03	
Southam Press Fund	76.43	
Cash on hand	14.84	
Coupons on hand	15.76	
		$717.06
RECEIPTS		
Grant received, Ontario	$ 500.00	
" " Canada	1,620.00	
		2,120.00
Fees and Subscriptions		2,278.98
Publications		831.23
Bonds sold		200.00
U.S.A. Exchange		74.75
Bond Interest		86.88
Bank Interest		3.26
Total		$6,312.16
DISBURSEMENTS		
Bonds purchased		$250.00
Publications		3,308.92
Public Meetings		36.00
Stamps and Stationery		270.38
Salaries		800.00
Grants to Centres		694.88
Rent		133.00
Janitor		21.00
Chant Medal		6.75
Insurance		25.50
General Expense		99.52
Transfer to Life Membership Account		1.50
		$5,647.45
Cash in bank	$613.75	
Cash on hand	50.96	664.71
		$6,312.16

Toronto, January 14, 1944

Audited and certified correct:

ANDREW THOMSON, *Auditor*
H. W. BARKER, *Auditor*

J. H. HORNING,
General Treasurer.

II. REPORTS OF TREASURERS OF CENTRES

TORONTO CENTRE

Receipts		Disbursements	
Balance from previous year	$217.98	Rentals	$ 40.00
Grant from General Council	170.50	Postage and Stationery	72.01
Bank Interest	nil	Expenses re meetings	56.15
Members' Fees	390.00	Expenses re Tercentenary Commemoration of the invention of the barometer—Toronto Centre's proportion of net total of $31.76	10.59
		Balance carried forward	209.73
		Fees to General Treasurer	390.00
Totals	$778.48		$778.48

December 7th, 1943.

T. H. Mason, *Treasurer.*

OTTAWA CENTRE

Receipts		Disbursements	
Balance from previous year	$214.10	Fees to General Treasurer	$ 98.00
(39) Members' Fees	84.00	Postage and Stationery	13.91
Grant from General Council	49.00	Expenses of meeting	34.51
Sale of Handbooks	25.20	Purchase of Handbooks	21.55
Bank Interest	.37	Balance carried forward	204.70
Totals	$372.67		$372.67

December 3rd, 1943.

A. C. Steedman, *Treasurer.*

HAMILTON CENTRE

Receipts		Disbursements	
Balance from previous year	$ 25.00	Rentals	$ 12.50
(42) Members' Fees	84.00	Fees to General Treasurer	86.00
Grant from General Council	43.00	Postage and Stationery	7.89
Bank Interest	.04	Expenses re printing	9.25
Donation	5.00	Caretaker	1.00
		Balance carried forward	40.40
Totals	$157.04		$157.04

James R. Graham, *Sec.-Treasurer.*

WINNIPEG CENTRE

Receipts		Disbursements	
Balance from previous year	$ 52.90	Rentals	$ 6.00
(26) Members' Fees	52.47	Fees to General Treasurer	54.00
Grant from General Council	33.50	Postage and Stationery	10.34
Bank Interest	.29	Expenses re meeting	10.00
			$ 80.34
		Balance carried forward	58.82
Totals	$139.16		$139.16

Miss Shirley Colquette, *Treasurer.*

MONTREAL CENTRE

Receipts		
Cash on hand and in bank October 15, 1942		$287.73
Members' Fees (256½ at $2.00 each)	$513.00	
Grant from General Treasurer, Toronto	152.00	
Interest on Bank Deposits	5.79	
Exchange on cheque	.10	
Total received during the year		670.89
Total Cash Debit		$958.62

Disbursements		
Membership Fees remitted to General Treasurer	$513.00	
Sundry expenses re meetings, including janitor and lantern services	40.00	
Travelling expenses of lecturers	10.60	
Stationery	45.47	
Postage	32.18	
Publicity (advertising, showcards and notices)	133.57	
Books and magazines for the library	12.80	
Transfer of Library, $2.00; Telegr., $1.95; Exch., 40c	4.35	
Total disbursed during the year		791.97
Leaving Balance on Hand October 15, 1943, of		$166.65
Consist of balance in passbook	$682.15	
Less outstanding cheques	515.50	
	$166.65	

F. De Kinder, *Treasurer.*

VICTORIA CENTRE

Receipts		Disbursements		
Balance from previous year	$ 31.65	Rentals		$ 18.00
Members' Fees	168.75	Fees to General Treasurer		111.50
Grant from General Council	64.25	Postage and Stationery		44.74
Bank Interest	.62	Expenses re meetings		16.93
Summer Course proceeds	14.47	Sundry:		
		Annual Dinner, 1942	$ 8.20	
		Bookcase	21.00	
		Telescope expense	4.45	
		Library	19.63	
		Blackouts	5.00	
		Flowers	5.50	
				63.78
		Balance carried forward		24.79
Totals	$279.74			$279.74

Miss V. Yarwood, *Treasurer.*

LONDON CENTRE

Receipts		Disbursements		
Balance from previous year	$ 51.35	Rentals		$ 4.03
Members' Fees	105.00	Fees to General Treasurer		107.00
Grant from General Council	35.85	Postage and Stationery, Secretarial		16.34
Bank Interest	.55	Expenses re meeting		14.19
Banquet	31.20	Books		5.99
		Banquet		40.80
		Miscellaneous		1.57
				$189.92
		Balance carried forward		34.03
Totals	$223.95			$223.95

R. H. Cole, *Sec.-Treasurer.*

EDMONTON CENTRE

Receipts		Disbursements	
Balance from previous year	$ 96.96	Expenses re meeting, janitors	$ 10.53
Members' Fees	111.00	Refreshments	6.90
Grant from General Council	35.00	Parent Society	70.00
Bank Interest	1.83	Memorial flowers	3.03
Students' Handbooks	4.00	Secretary's pin money	1.00
		Treasurers's pin money	6.50
		Telescope dedication	4.03
		Moon framed	2.40
		Book Store and printing	30.37
		Balance carried forward	114.03
Totals	$248.79		$248.79

A. M. P. Smith, *Treasurer.*

VANCOUVER CENTRE

Receipts		Disbursements	
Balance from previous year	$ 9.64	Rentals	nil
Members' Fees (47)	94.00	Fees to General Treasurer	$ 94.00
Grant from General Council	30.00	Postage and Stationery	25.86
Bank Interest	.73	Expenses re meetings	28.90
Total	$134.37	Total	$148.76
Deficit	14.39		
Total	$148.76	Total	$148.76

F. G. Berton, *Treasurer.*

CENTRE DE QUÉBEC

Receipts		Disbursements	
Balance from previous year	$ 28.36	Rentals	$ 28.12
Members fees (1943)	102.00	Fees to General Treasurer	147.00
" " (1944)	10.00	Postage and Stationery	31.14
Grant from General Council	77.63	Expenses re meetings	5.89
Private gifts	110.00	Repairs to Observatory	17.45
Grant Provincial Government	200.00	Light and Heat	53.57
Loan	62.20	Bank charges	.80
Bank Interest	.04	Furniture and fixtures	14.16
		Betterment	86.37
		Balance carried forward	205.75
Totals	$590.23		$590.23

J. Lucien Pouliot, *Treasurer.*

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Bryner, L., R.R. 2, Kent, Ohio.
Buscombe, W., Box 308, Moncton, N.B.
Bussard, R., 271 N. Bowling Green, Los Angeles 24, Calif.
Byrne, J. J., 1678 Sacramento St., San Francisco, Calif.
Calvert, Prof. R., Utah State Agricultural College, Logan, Utah.
Davis, Bruce, 73 Victoria Blvd., Kenmore 17, N.Y.
Dewar, J. W., R.C.A.F. Station, Yarmouth, N.S.
Eddinger, L. S., 115 S. Oak St., Berwick, Penna.
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Fontaine, H., Mansonville, Quebec.
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Leist, L., 103 South 7th St., Lamar, Colo.

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WEAVER, H. F., 6—105 Massachusetts Institute of Technology, Cambridge, Mass.
WINKEL, E. F., 11917 Buckingham, Cleveland 6, Ohio.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

Science and Religious Belief in England

During the last thousand years the discoveries in astronomy have profoundly influenced the development of human thought, especially in its relation to religious belief; and in the last hundred years the phenomenal growth of all branches of science has completely transformed the manner of life of all civilized nations. One would naturally look for some treatment of this subject in such a work as *English Social History* by G. M. Trevelyan, from which a quotation was made in our last issue. The sub-title of the book is "A survey of six centuries, Chaucer to Queen Victoria", and the paragraphs which follow may give some notion of its absorbingly interesting nature.

Referring to the time of Charles II (1660-1685), under whose patronage the Royal Society was founded, we read:

> The uses to which science might be turned, in agriculture, industry, navigation, medicine and engineering, appealed to the practical English mind. Another hundred years were to pass before the Industrial Revolution gathered full force, largely as a result of the application of science to manufacture, but already in the reign of Charles II many subjects of daily importance were being studied in a scientific spirit, and this new spirit already had a great influence on educated thought in England. Robert Boyle, Isaac Newton and the early members of the Royal Society were religious men, who repudiated the sceptical doctrines of Hobbes. But they familiarized the minds of their countrymen with the idea of law in the Universe and with scientific methods of inquiry to discover truth. It was believed that these methods would never lead to any conclusion inconsistent with Biblical history and orthodox doctrine; Newton lived and died in that faith. But his law of universal gravitation and his calculus supplied methods of approaching truth that had no relation to theology. The spread of scientific enquiry affected the character of religious belief, though not as yet its content. The age of latitudinarian piety that followed the Revolution of 1688 was being prepared by these intellectual movements of the Restoration.
>
> Early in the reign of Charles II, the first "History of the Royal Society", its character and aims, was written by Sprat, some years later Bishop of Rochester, a man highly characteristic of the new age both in the versatility of his mind and the politic flexibility of his opinions. This High Church divine commends the "learned and inquisitive age" in which he lives, praises the practical objects of the Fellows of the Royal Society, "to increase the powers

of all mankind and to free them from the bondage of errors", and claims for these new philosophers the widest range of inquiry—"these two subjects, God and the Soul, being only forborne: in all the rest they wander at their pleasure". God was to be praised by studying the plan of His creation, but no further attempt was to be made to fit the findings of science into the scheme of theology, as the schoolmen of old had striven so long and so painfully to do. "God and the Soul" were taken for granted—and left aside. It was an orthodox position no doubt, not essentially religious. God was no longer all in all. In a world governed by such studies, superstition would be exposed, and poetry would yield pride of place to prose; would even religion be quite the same again?

Sprat was one of the excellent writers who formed the lucid prose of the Restoration era, but he was not an original thinker, and his book on the Royal Society (1667) is on that account all the more symptomatic of the mind of the new age. Like Locke and Newton a few years later, the Bishop concedes to "the ancient miracles" of Bible times a passport as privileged phenomena, unusual interferences of God with this creation. But modern miracles were no longer to be expected in the Protestant, Anglican climate. "The course of things", Sprat declares, "goes quietly along, in its own true channel of natural causes and effects". It is no longer even Shakespeare's world: "King Oberon and his invisible army of fairies" are "false chimeeres" to this philosopher Bishop. When the Englishmen of the Revolution laughed at "Popish miracles", it was not only because they were Popish but because they were miracles. Sprat even warns his too credulous countrymen "not to be party in assigning the causes of plagues, or fires or inundations" to the judgments of God or sin. Finally, "the new philosophy" of the physical sciences is to be the mother of inventions useful to man, enriching and comforting his life. "While the old philosophy could only bestow on us some barren terms and notions, the new shall impart to us the uses of all the creatures and shall enrich us with all the benefits of fruitfulness and plenty".—pp. 256-258.

John Locke (1632-1704) was a distinguished mental philosopher and author of the famous *Essay Concerning Human Understanding*.

Locke's *Reasonableness of Christianity* (the very title marks a new brand of thought and religion) was the starting point of two movements, the Latitudinarianism that became for a while the prevalent tone of the Established Church, though not of Methodism; and the English Deistic movement which all respectable people regarded askance.—p. 354.

* * * * *

The harmony of science and religion was nobly symbolized by the erection in 1755 of Roubillac's statue of Newton in the ante-chapel at Trinity College, Cambridge.—p. 355.

* * * * *

The Latitudinarian stood for the spirit of Tolerance, for lack of which Christianity had for centuries past wrought cruel havoc in the world it set out

to save; the Latitudinarian stood also for Reasonableness in the interpretation of religious doctrines, without which they were unlikely to be received by the more scientific modern mind. Methodism, on the other hand, renewed the self-discipline and the active zeal without which religion loses its power and forgets its purpose; and this new evangelism was allied to an active philanthropy. Both the Latitudinarianism and the Methodism of that era have suffered change with the changing times. But the principles which they respectively rescued and embodied have flourished in new forms and combinations, which preserved religion as a powerful force in English life through many changing generations. —p. 356.

* * * * *

By the time that George III ascended the throne [1760] the political motive for Latitudinarianism ceased to operate. But the movement continued, driven forward by its own momentum and by forces deeper than political. Locke and Newton ruled from their graves. The increasingly scientific spirit of the age demanded that "the reasonableness of Christianity" should be proved and emphasized. The miraculous seemed less actual, and to some less credible. "Unalterable law" in the Universe, such as the law of gravitation which preserved the stars from wrong, was now regarded as an attribute of God's glory.

> The spacious firmament on high,
> With all the blue Etherial sky,
> And spangled Heavens, a shining frame
> Their great Original proclaim.
> Th' unwearied Sun, from day to day,
> Does his Creator's Power display
> And publishes to every land
> The work of an Almighty hand.

That hymn of Addison's had appeared in the *Spectator* in 1712, but it echoed down the Century, till young Coleridge and Wordsworth "took up the wondrous tale".—pp. 356-7.

* * * * *

In the Twentieth Century, on the other hand, self-discipline and self-reliance are somewhat less in evidence, and a quasi-religious demand for social salvation through State action has taken the place of older and more personal creeds. Science has undermined the old forms of religious belief, but even now the strength and the weakness of England cannot be undestood without some knowledge of her religious history.—p. 510.

* * * * *

English religion had been an imposing fabric in the middle of the Nineteenth Century but there had been a weakness in its foundations which the movement of scientific discovery was certain to undermine: the belief in the verbal inspiration of the Bible was common to the Noncomformists, to the Church Evangelicals and, to a scarcely less degree, to High Churchmen like Bishop Samuel Wilberforce and Mr. Gladstone. Charles Darwin was as unlike Voltaire as any human

being could well be; he had no wish to be an iconoclast; he did not regard the Church as "the infamous"; and in the end she reverently buried him in Westminster Abbey. But his scientific researches led him to conclusions incompatible with the narrative of the early chapters of Genesis which were as much a part of "the English Bible" as the New Testament itself. More generally speaking, the whole idea of evolution and of "man descended from a monkey" was totally incompatible with existing religious ideas of creation and of man's central place in the Universe.

Naturally the religious world took up arms to defend positions of dateless antiquity and prestige. . . . The strife raged throughout the 'sixties, 'seventies and 'eighties. It came to involve the whole belief in the miraculous, extending into the borders of the New Testament itself. The "intellectuals" became more and more anti-clerical, anti-religious and materialistic under the stress of the conflict. . . . Both sides wistfully acknowledge that the whole truth about the Universe cannot be discovered in the laboratory or divined by the Church. But where it can be found is a more difficult matter to determine.—pp. 565-6.

Finally, the present writer, an old Victorian and an admirer of Tennyson's poetry from his boyhood, has some satisfaction in quoting the foot-note to page 566:

People unduly depreciate Tennyson's intellectual acumen, as shown in the poems he wrote in the formative period of his youth before he took to hymning King Arthur's knights. His *In Memoriam*, written in the 'forties, and published in 1850, nine years before the appearance of Darwin's *Origin of Species*, anticipated the poignancy of the struggle between Faith and Science that convulsed the following era.

The above quotations from Trevelyan's *English Social History* are made with the permission of the publishers, Messrs. Longmans, Green and Co.

C. A. C.

Laboratories and Barbed Wire

In addition to its more extensive reports, the Rockefeller Foundation each year publishes a briefer review of its work. Outlines of the more spectacular advances in medical, natural and social sciences, and in the humanities, as aided by this great foundation, are included. From the Review of 1943, by the President, Dr. Raymond B. Fosdick, we quote the following appraisal of pure research.

In spite of this gratifying record, it must not be supposed that fundamental research has continued during the war in anything like the same volume as before. It is in fact today a mere trickle compared with the mighty stream it formerly was. Valuable as it is to keep alive the tradition of fundamental research, it must nevertheless be admitted that it is not in war but in peace

that the advance of knowledge, as distinguished from the application of knowledge, finds its favorable environment. A nation at war has little time or inclination for pure research—the clean, clear urge to gain new knowledge, the sympathetic appreciation of imaginative scholarship even when it seems remote and unrelated. There is a sense in which the practical applications of knowledge are the dividends which pure science from time to time declares. When pure science is even temporarily interrupted, then it is necessary to pay these dividends out of surplus; and obviously this process cannot long continue.

But when peace comes, work can recommence on building up the capital, enlarging the reservoirs of knowledge upon which men have drawn during relatively unproductive years. And this will be possible because wartime barriers will be down and the search for truth can go forward in a free intellectual world. Freedom of intercourse and discussion and the publication of results, not only within a nation but across all boundaries, are essential conditions of fundamental research.

In wartime, science and learning are necessarily partisan, but this is a perversion of their real character. When the war is done, men will again have access to all knowledge, wherever it may be found, and armed guards will no longer protect the secrets of research that might bring health and a better life to the race. Laboratories surrounded by barbed wire are ugly monuments to the intellectual and moral distortion of our times.

For of all the activities of men, science and learning are the most truly international. They alone seem to be capable of transcending the follies and absurdities of national rivalries. The search for truth, the experimental method, the eager application of new discovery to human ills—these speak in a tongue which meets with universal understanding. These constitute perhaps the strongest link between intelligent people in all countries, no matter what flag flies over their frontiers.

It is a significant symbol of this common link that the astronomers of the world, even in time of war, have defied the boundary lines that sought to prevent the exchange of information dealing with the universe. A new comet discovered by Diamaca, a Roumanian, is reported by radio at Bucharest to the Royal Astronomer of Denmark, and by him to the Observatory of Zurich, and then to Harvard Observatory. Professor August Kopff of Berlin sends word by way of Copenhagen and Stockholm that a nova of the twelfth magnitude in Aquila has been discovered, and the information is immediately checked in observatories in all countries. Under the auspices of the Department of State, the Harvard Observatory publishes, in mimeographed form, "Astronomical News Notes," which goes by mail, directly and indirectly, to probably all the observatories of the world.

If in the midst of the bitterest conflict in history the discovery of a comet or of a new universe of stars can link together astronomers of warring nations, surely there is hope that when peace comes, the fellowship of research and the common language of science and learning can be a strong base on which to help build a coherent and integrated world. F. S. H.

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1890-1943

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